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Ueda et al.

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(54) **CONNECTOR AND INFUSION SET**

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A61M 39/26 (2006.01)

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U.S. Cl.

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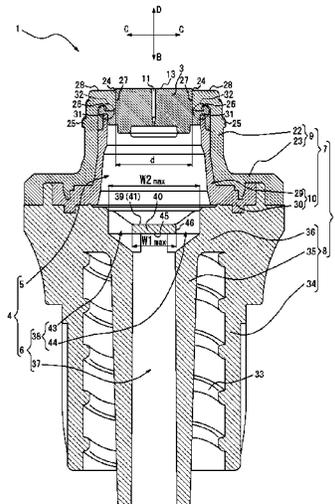
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(57) **ABSTRACT**

A connector includes a housing including: an insertion section into which a male connector is insertable from an outside of the housing, and a flow path communicating with the insertion section; and an elastic valve body having a slit and configured to block the insertion section. An inner wall of the housing defining the flow path is integrally formed with a liquid barrier face. The housing is configured such that, when the male connector is inserted in the insertion section, the liquid barrier face faces a tip opening of the male connector in an insertion direction of the male connector such that liquid flowing out from the tip opening collides with the liquid barrier face.

14 Claims, 16 Drawing Sheets



(58) **Field of Classification Search**

USPC 604/256

See application file for complete search history.

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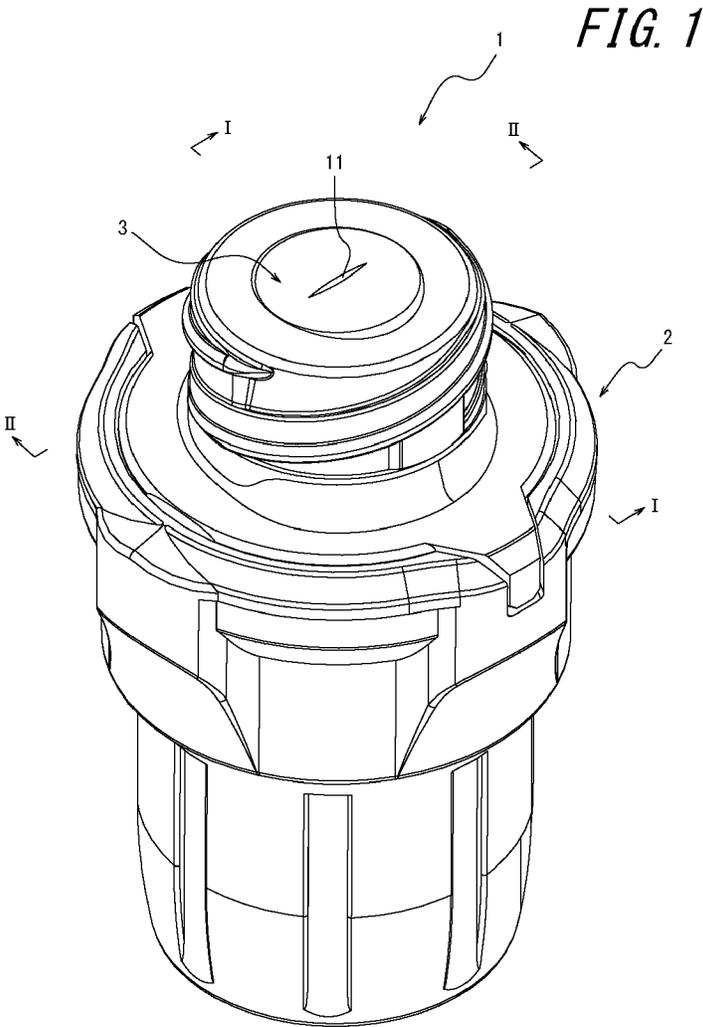
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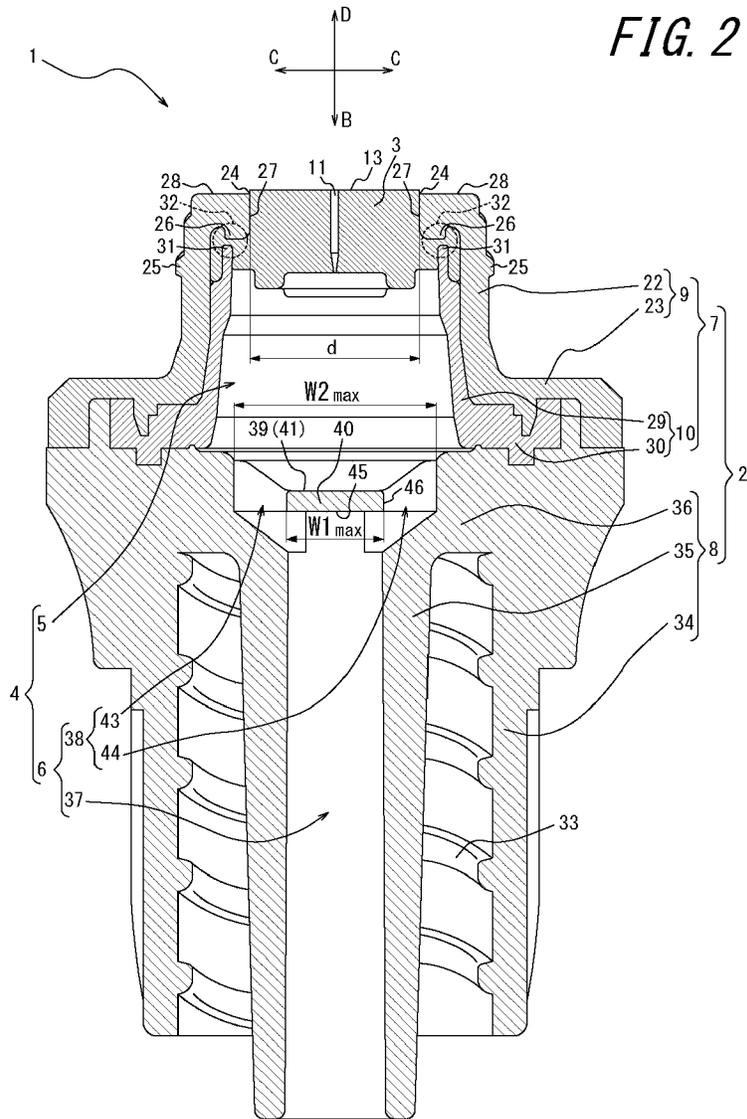
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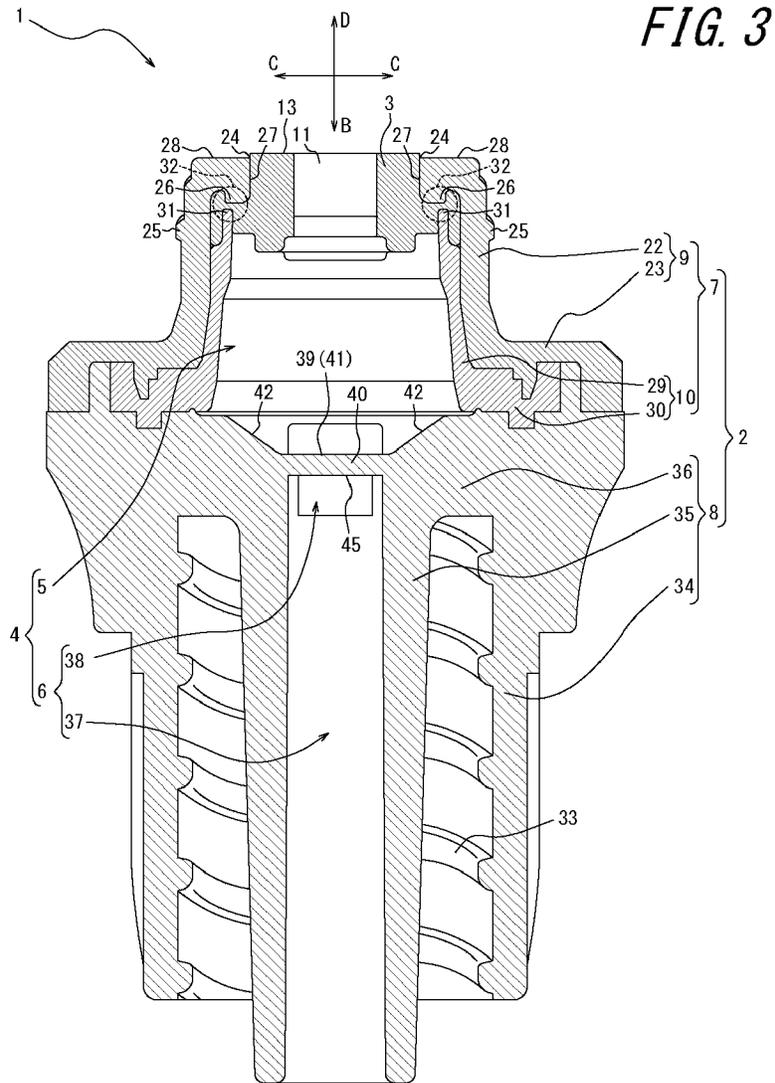


FIG. 4

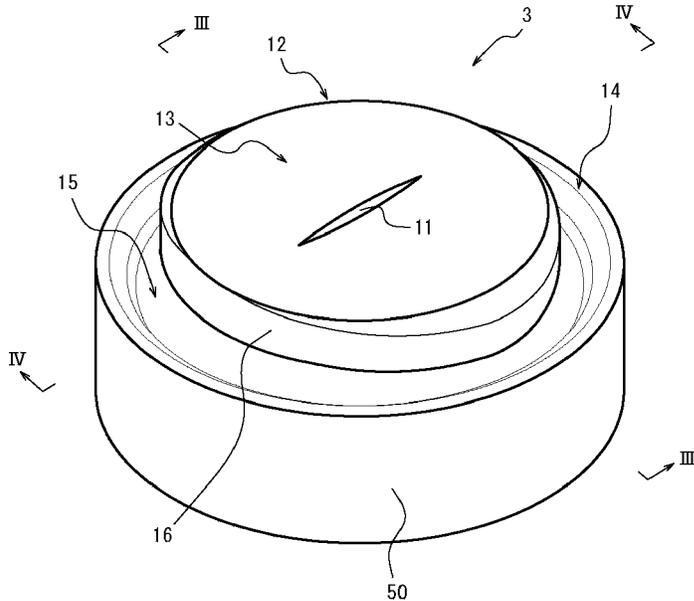


FIG. 5A

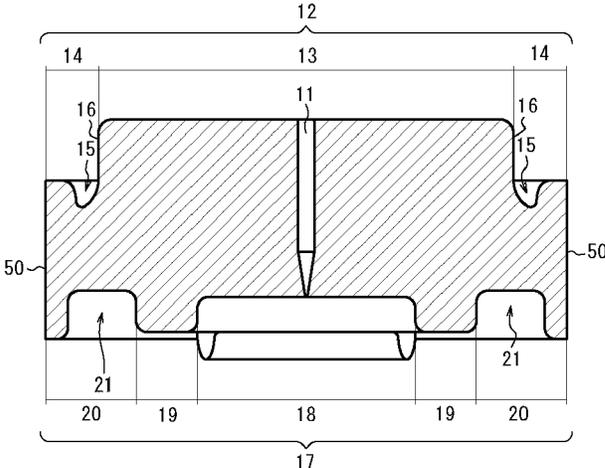


FIG. 5B

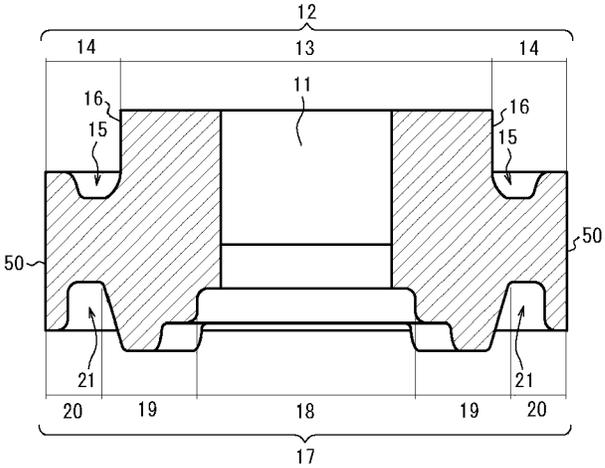


FIG. 6

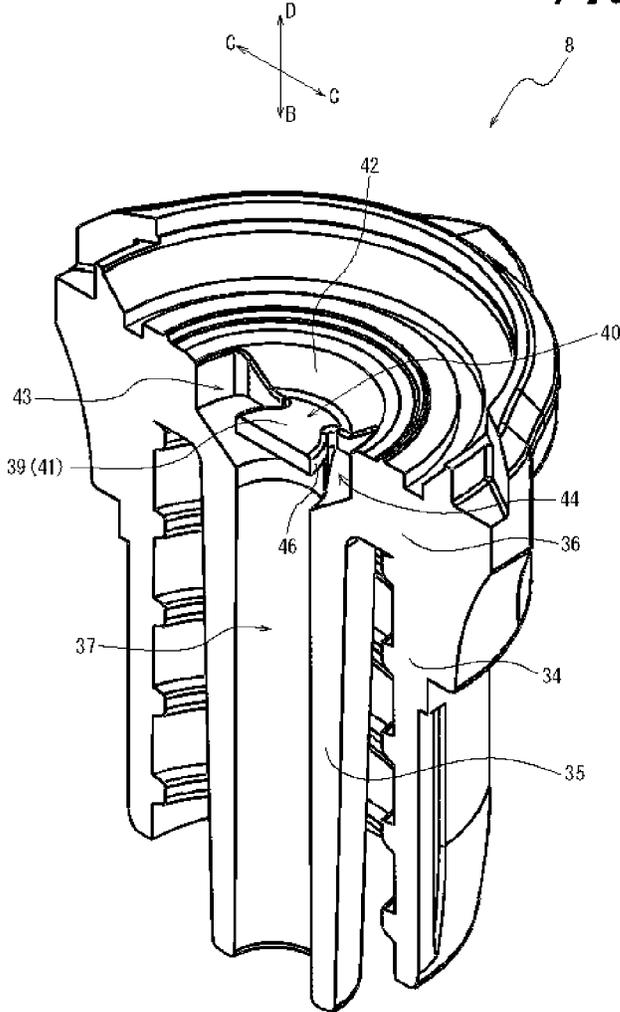


FIG. 7

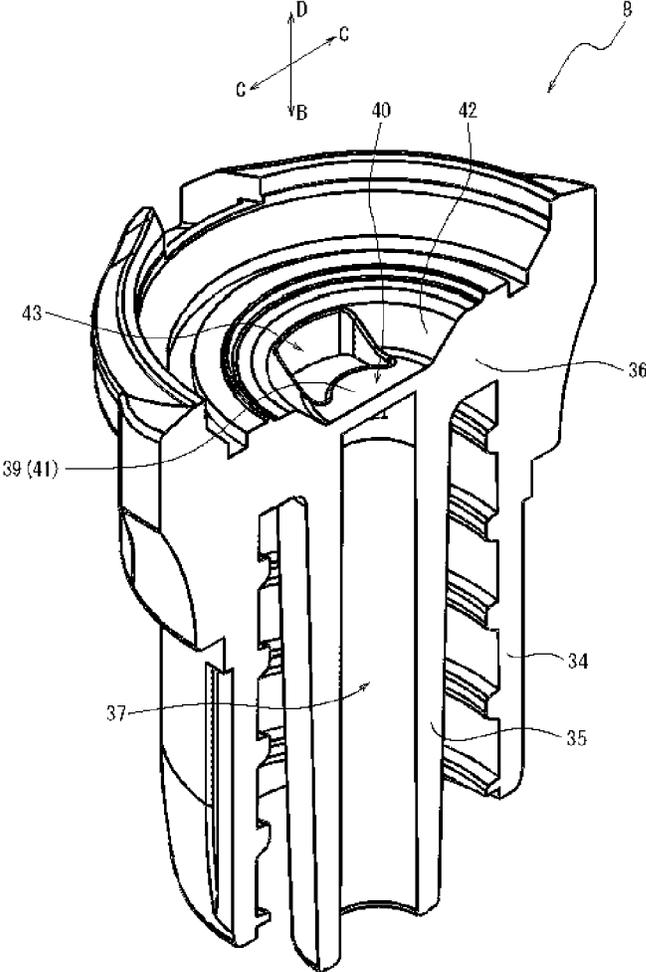


FIG. 8

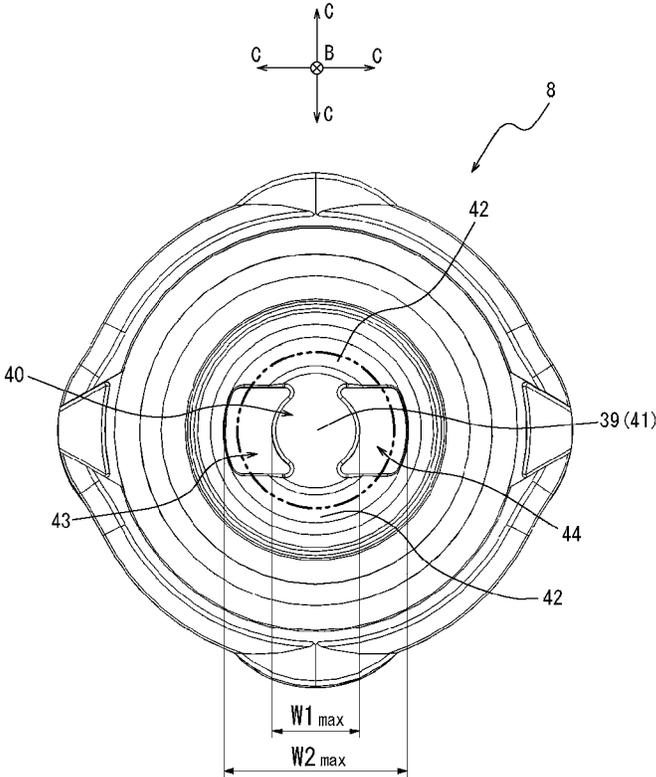


FIG. 9

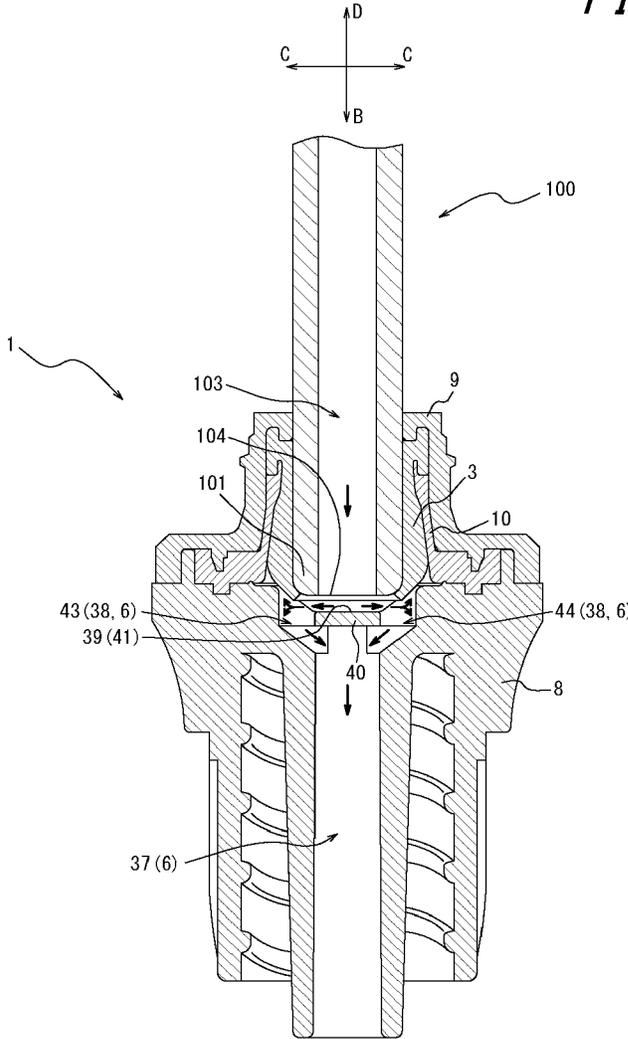
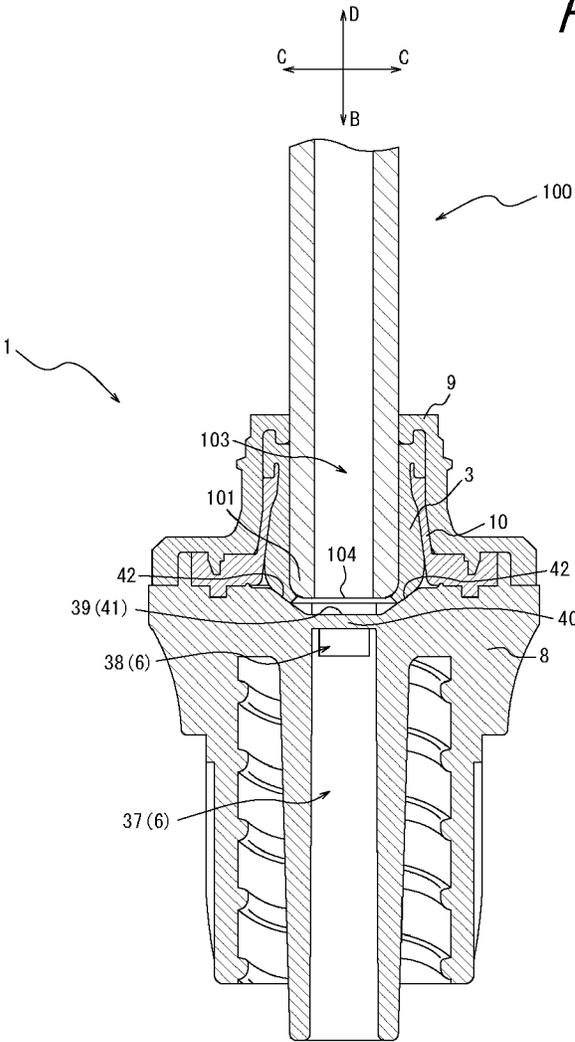


FIG. 10



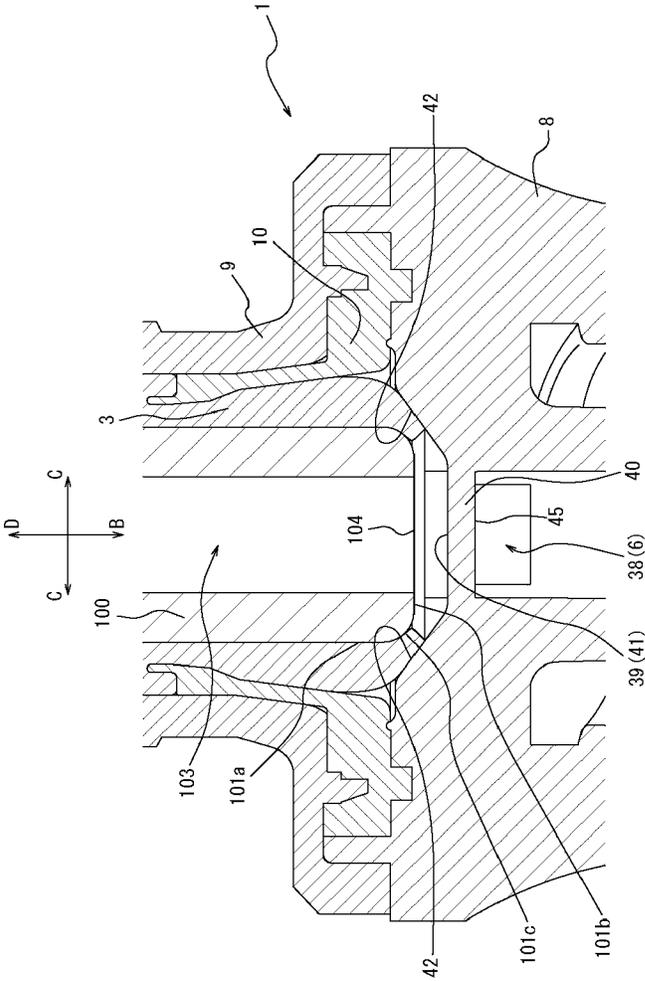


FIG. 11

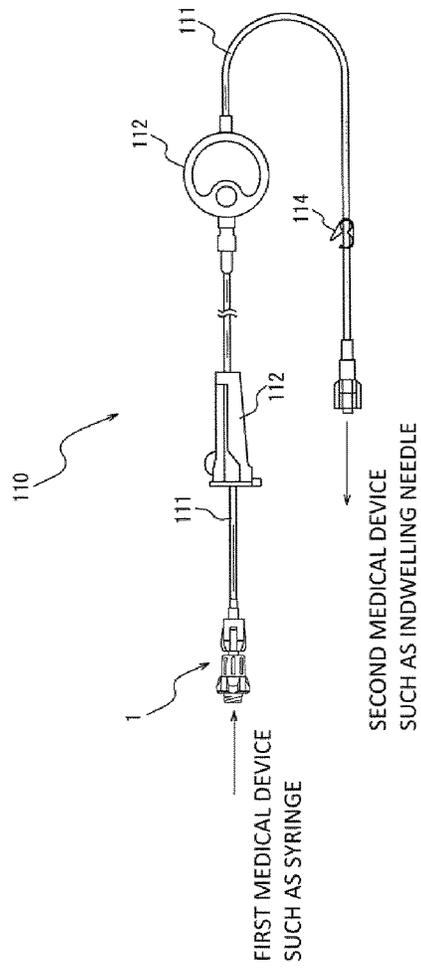


FIG. 12

FIG. 13

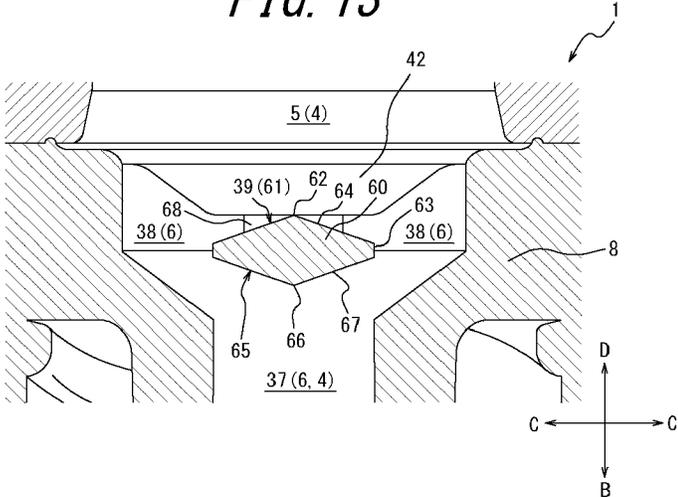


FIG. 14

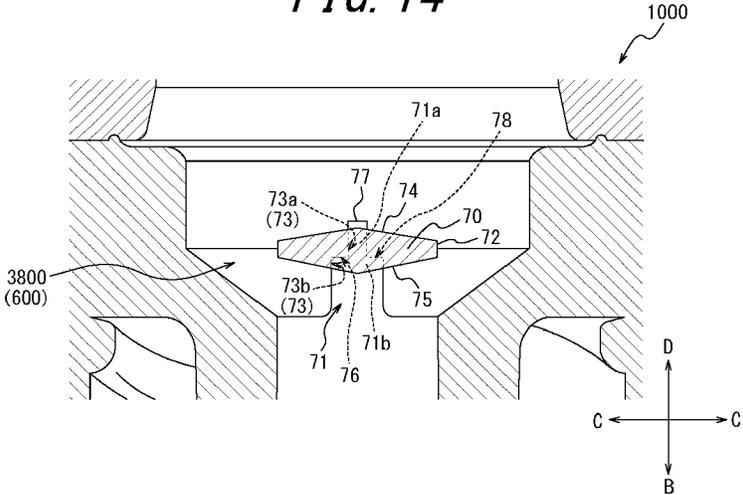


FIG. 15

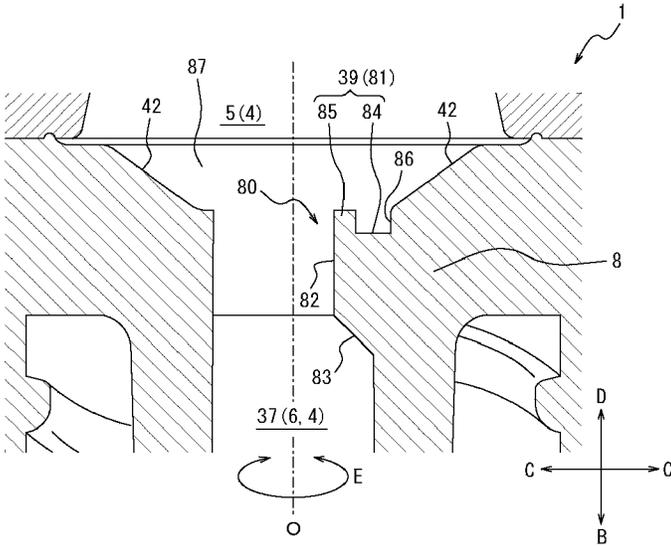


FIG. 16

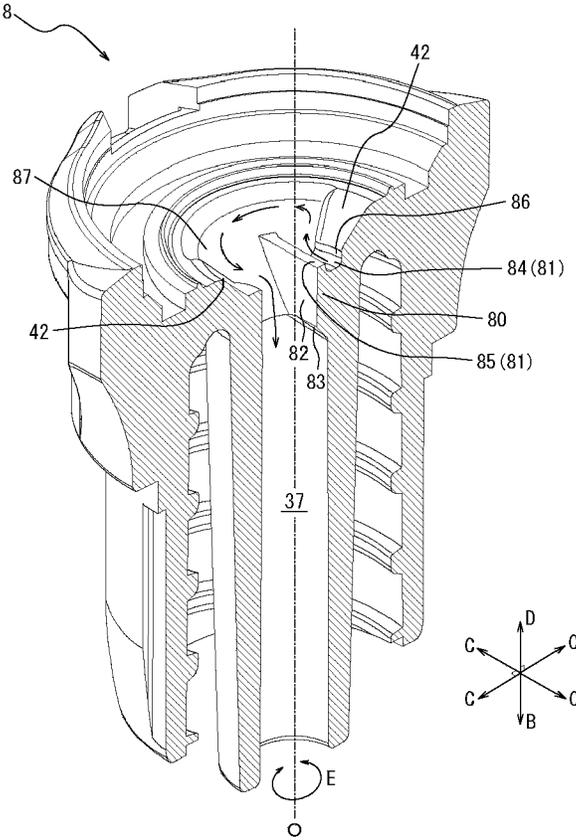
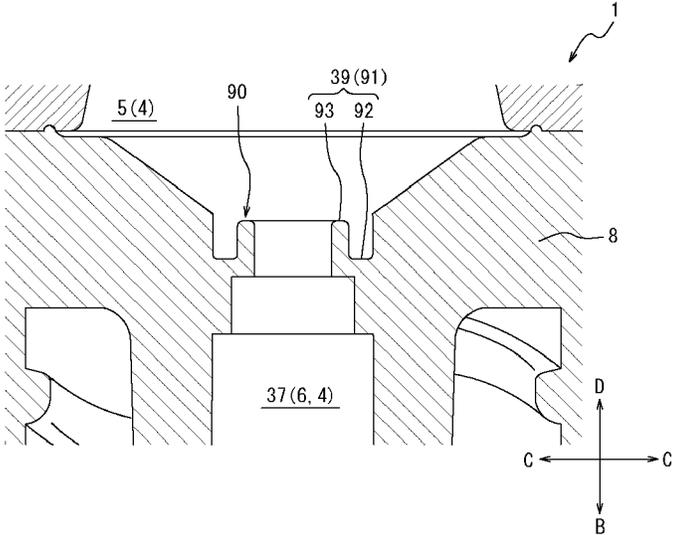


FIG. 17



CONNECTOR AND INFUSION SET**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is a continuation application of and claims the benefit of priority from International Patent Application No. PCT/JP2015/001643, filed Mar. 23, 2015, which claims priority to Japanese Patent Application No. 2014-064302, filed on Mar. 26, 2014, the entireties of which are hereby incorporated by reference.

BACKGROUND

The present disclosure relates to a connector and an infusion set. In particular, the present disclosure relates to a connector that is capable of connecting thereto a male connector and an infusion set using the connector.

Conventionally, when infusion, blood transfusion, or artificial dialysis is performed, liquid is fed into the body using a medical tube. When another liquid such as liquid medicine is joined to the liquid inside the tube, a connector that is capable of liquid-tightly connecting a male connector such as a syringe and a luer taper member to the medical tube is used. A male connector such as a syringe and a luer taper member may be called a male luer, and a connector connected to the male luer may be called a female luer.

WO 2005/004973 discloses a mixture injection port as a connector in which one end of a channel tube is covered by a septum provided with a slit into which a tube member is inserted. The channel tube is provided with a circulating portion for circulating a fluid injected from the inserted tube member or a fluid flowing toward the tube member to the septum side and then guiding the fluid to the downstream side of the channel tube or a tip of the tube member.

SUMMARY

The mixture injection port disclosed in WO 2005/004973 has a configuration in which the circulating portion, which is a member different from the channel tube, is mounted inside the channel tube as a housing. Therefore, there is a problem that manufacturing process need to include a step of mounting the circulating portion inside the channel tube, resulting in difficult manufacturing of the mixture injection port.

In consideration of the above problem, certain embodiments of the present invention provide a connector and an infusion set capable of suppressing continuous stagnation of internal liquid with a simple configuration.

A connector of a first aspect of the present invention includes a housing defining an insertion section into which a male connector is inserted from the outside and a flow path communicating with the insertion section and an elastic valve body which has a slit and blocks the insertion section. An inner wall defining the flow path is integrally formed with a liquid barrier face which faces a tip opening of the male connector inserted in the insertion section in an insertion direction of the male connector and collides with liquid flowing out from the tip opening.

As an embodiment of the present invention, preferably, the housing includes a partition section dividing the flow path in a direction perpendicular to the insertion direction and the liquid barrier face includes an upstream face which is a face of the partition section on an upstream side of the insertion direction.

As an embodiment of the present invention, preferably, the partition section divides the flow path into a plurality of separated flow paths in the direction perpendicular to the insertion direction.

As an embodiment of the present invention, preferably, the upstream face is a plane extending in the direction perpendicular to the insertion direction.

As an embodiment of the present invention, preferably, the upstream face is an inclined face descending from the upstream side to the downstream side of the insertion direction.

As an embodiment of the present invention, preferably, the partition section has a substantially round-shaped outer shape when seen from the insertion direction.

As an embodiment of the present invention, preferably, the housing includes a projecting wall section projecting toward the inner side from the inner wall and the liquid barrier face includes an upstream face which is a face of the projecting wall section on the upstream side of the insertion direction.

As an embodiment of the present invention, preferably, a maximum width of the partition section interposed between the flow paths is smaller than an internal diameter of the housing defining an insertion opening that is one end of the insertion section when the housing is seen from the insertion direction.

As an embodiment of the present invention, preferably, the inner wall defining the flow path is integrally formed with a tip receiving face to receive a tip of the male connector and the liquid barrier face is positioned on the downstream side with respect to the tip receiving face in the insertion direction.

An infusion set as a second aspect of the present invention includes the above connector.

Certainly embodiments of the present invention allow for providing a connector and an infusion set capable of suppressing continuous stagnation of internal liquid with a simple configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating a connector as an embodiment of the present invention.

FIG. 2 is a cross-sectional view taken along line I-I of FIG. 1.

FIG. 3 is a cross-sectional view taken along line II-II of FIG. 1.

FIG. 4 is a perspective view of an elastic valve body alone.

FIG. 5A is a cross-sectional view taken along line III-III of FIG. 4. FIG. 5B is a cross-sectional view taken along line IV-IV of FIG. 4.

FIG. 6 is a cross-sectional perspective view of a holder alone illustrating the same cross section as that of the connector illustrated in FIG. 2.

FIG. 7 is a cross-sectional perspective view of the holder alone illustrating the same cross section as that of the connector illustrated in FIG. 3.

FIG. 8 is a top view of the holder alone seen from an insertion direction of a male connector.

FIG. 9 is a cross-sectional view, of the connector inserted with the male connector, illustrating the same cross section as that in FIG. 2.

FIG. 10 is a cross-sectional view, of the connector inserted with the male connector, illustrating the same cross section as that in FIG. 3.

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FIG. 11 is an enlarged cross-sectional view where a tip and the vicinity thereof of the male connector are enlarged from the cross section illustrated in FIG. 10.

FIG. 12 is a diagram illustrating an infusion set as an embodiment of the present invention.

FIG. 13 is a cross-sectional view illustrating a modification of a partition section in the connector illustrated in FIG. 1.

FIG. 14 is an enlarged cross-sectional view of a connector including a partition member having a similar shape to that of the partition section illustrated in FIG. 13.

FIG. 15 is a cross-sectional view illustrating a modification of a liquid barrier face in the connector illustrated in FIG. 1.

FIG. 16 is a cross-sectional perspective view, of the holder alone including a projecting wall section illustrated in FIG. 15, illustrating the same cross section as that of the connector illustrated in FIG. 3.

FIG. 17 is a cross-sectional view illustrating a modification of a liquid barrier face in the connector illustrated in FIG. 1.

DETAILED DESCRIPTION

Hereinafter, an embodiment of a connector and an infusion set according to the present invention will be described with reference to FIGS. 1 to 17. Common members are denoted by identical symbols throughout the drawings.

First, an embodiment of the connector according to the present invention will be described. FIG. 1 is a perspective view illustrating a connector 1 as the present embodiment. FIGS. 2 and 3 are cross-sectional views taken along line I-I and line II-II of FIG. 1, respectively.

As illustrated in FIGS. 1 to 3, the connector 1 includes a housing 2 and an elastic valve body 3 attached to the housing 2. Specifically, the connector 1 includes the housing 2 defining a hollow section 4 and the elastic valve body 3 positioned in the hollow section 4. The hollow section 4 includes an insertion section 5 into which a male connector 100 (see FIG. 9, etc.) is inserted from the outside and a flow path 6 communicating with the insertion section 5. The elastic valve body 3 blocks the insertion section 5. The "flow path communicating with the insertion section" includes not only a flow path directly connected to the insertion section but also a flow path connected to the insertion section via a separate space. The flow path 6 of the present embodiment is directly connected to the insertion section 5.

The housing 2 includes a cap 7 defining the insertion section 5 into which the male connector 100 (see FIG. 9, etc.) is inserted from the outside and a holder 8 defining the flow path 6 and supporting the cap 7.

The cap 7 includes a top face cap 9 and a bottom face cap 10. The elastic valve body 3 is compressed and clamped by the top face cap 9 and the bottom face cap 10 and thereby positioned and fixed in the hollow section 4, specifically, in the insertion section 5.

The holder 8 defines the flow path 6. The holder 8 is a member to support the top face cap 9 and the bottom face cap 10. In the present embodiment, both of the top face cap 9 and the bottom face cap 10 are in contact with and supported by the holder 8; however, the bottom face cap 10 may be held by the top face cap 9, thereby allowing only the top face cap 9 to be in contact with the holder 8 and to be supported by the holder 8. Conversely, the top face cap 9 may be held by the bottom face cap 10, thereby allowing only the bottom face cap 10 to be in contact with the holder 8 and to be supported by the holder 8.

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In the present embodiment, the top face cap 9 and the bottom face cap 10 define the insertion section 5. The holder 8 further defines a part of the insertion section 5 and the flow path 6.

Examples of the materials of the holder 8 included in the housing 2 as well as the top face cap 9 and the bottom face cap 10 as the cap 7 include various resin materials such as: polyolefin such as polyethylene, polypropylene, and an ethylene-propylene copolymer; an ethylene-vinyl acetate copolymer (EVA); polyvinyl chloride; polyvinylidene chloride; polystyrene; polyamide; polyimide; polyamide-imide; polycarbonate; poly(4-methyl-1-pentene); ionomer; an acrylic resin; polymethyl methacrylate; an acrylonitrile-butadiene-styrene copolymer (ABS resin); an acrylonitrile-styrene copolymer (AS resin); a butadiene-styrene copolymer; polyester such as polyethylene terephthalate (PET), polybutylene terephthalate (PBT), and polycyclohexane terephthalate (PCT); polyether; polyetherketone (PEK); polyetheretherketone (PEEK); polyether imide; polyacetal (POM); polyphenylene oxide; modified polyphenylene oxide; polysulfone; polyether sulfone; polyphenylene sulfide; polyarylate; aromatic polyester (a liquid crystal polymer); and polytetrafluoroethylene, polyvinylidene fluoride and other fluororesins. A blend or a polymer alloy containing one or more kinds of the above resin materials may also be used. Alternatively, various glass materials, ceramic materials, or metal materials may be used.

The elastic valve body 3 has a slit 11 so that the elastic valve body 3 can elastically deform to open or close when the male connector 100 (see FIG. 9, etc.) is attached to or detached from the connector 1 and is arranged to block the insertion section 5 defined by the top face cap 9 and the bottom face cap 10 as the cap 7. Specifically, the elastic valve body 3 is clamped by a clamping section 32 formed by the top face cap 9 and the bottom face cap 10 and thereby positioned and fixed in the connector 1.

The elastic valve body 3 is molded and formed to be elastically deformable. Examples of the material of the elastic valve body 3 include: various rubber materials such as natural rubber, isoprene rubber, butadiene rubber, styrene-butadiene rubber, nitrile rubber, chloroprene rubber, butyl rubber, acrylic rubber, ethylene-propylene rubber, hydrin rubber, urethane rubber, silicone rubber, and fluoro rubber; and various thermoplastic elastomers such as a styrene-based thermoplastic elastomer, a polyolefin-based thermoplastic elastomer, a polyvinyl chloride-based thermoplastic elastomer, a polyurethane-based thermoplastic elastomer, a polyester-based thermoplastic elastomer, a polyamide-based thermoplastic elastomer, a polybutadiene-based thermoplastic elastomer, a transpolyisoprene-based thermoplastic elastomer, a fluoro rubber-based thermoplastic elastomer, and a chlorinated polyethylene-based thermoplastic elastomer. A mixture of one or two or more kinds of these materials may be used.

The hardness of the elastic valve body 3 is preferably 20 to 60° (A hardness). This allows for ensuring a moderate elastic force in the elastic valve body 3. Thus, elastic deformation (described later) can be generated in the elastic valve body 3.

Hereinafter, each member in the present embodiment will be described in detail.

[Elastic Valve Body 3]

FIG. 4 is a perspective view of an elastic valve body 3 alone. FIGS. 5A and 5B are cross-sectional views taken along line III-III and line IV-IV of FIG. 4.

As illustrated in FIGS. 4 and 5, the elastic valve body 3 is a round and flat disc-like valve body having a disc-like

outer shape. The top face **12** (upper face in FIGS. **5A** and **5B**) includes a planar top face central region **13** and a top face outer region **14** which is located on the outer side in the radial direction with respect to the top face central region **13**.

The top face central region **13** has a shape projecting outward (upward in FIGS. **5A** and **5B**) with respect to the top face outer region **14**. The straight slit **11** is formed in the center of the top face central region **13**. The slit **11** is molded. The slit **11** does not penetrate the elastic valve body **3** up to a bottom face **17** when molded, and penetrates the elastic valve body **3** up to the bottom face **17** when, for example, the male connector **100** (see FIG. **9**, etc.) is first inserted after the molding. A process of allowing the slit **11** to penetrate the elastic valve body **3** may be executed as a part of the manufacturing process after the molding is completed.

As illustrated in FIGS. **4** to **5B**, a top face annular groove **15** is formed on the top face outer region **14** in a manner to surround the top face central region **13**. A locking projection **26** (described later) (see FIGS. **2** and **3**) of the top face cap **9** enters the top face annular groove **15** and compresses the elastic valve body **3** to constitute a part of the clamping section **32** (see FIGS. **2** and **3**). In the top face annular groove **15** of the present embodiment, a groove wall adjacent to the top face central region **13** is formed in a circular arc shape in the sectional views of FIGS. **5A** and **5B**. Such a configuration enables a restoring performance of the elastic valve body **3** to be improved. In the present embodiment, although the top face annular groove **15** is formed at a position adjacent to the top face central region **13**, that is, a side wall **16** of the top face central region **13** projecting outward in the sectional views of FIGS. **5A** and **5B** constitutes also the groove wall of the top face annular groove **15**, the position or the shape of the top face annular groove **15** may be appropriately modified according to the position or the shape of the locking projection **26** of the top face cap **9**.

The bottom face **17** of the elastic valve body **3**, the bottom face **17** located opposite to the top face **12**, includes a planar bottom face central region **18**, a thick region **19** which is located on the outer side in the radial direction with respect to the bottom face central region **18**, and a bottom face outer region **20** which is located on the outer side in the radial direction with respect to the thick region **19**.

The slit **11** is not formed on the bottom face central region **18**. However, as described above, for example, when the male connector **100** is first inserted, a part between a tip of the slit **11** formed on the top face **12** and the bottom face central region **18** is split, which allows the slit **11** to communicate with the top face central region **13** through to the bottom face central region **18**.

The thick region **19** projects outward (downward in FIGS. **5A** and **5B**) with respect to the bottom face central region **18** and the bottom face outer region **20**. In a configuration that is not provided with the thick region **19**, when an excessive load is applied to the elastic valve body **3** during insertion or removal of the male connector **100** or when the male connector **100** is repeatedly attached and detached, longitudinal ends of the communicating slit **11**, the longitudinal ends facing the bottom face **17**, may disadvantageously be split. The thick region **19** reinforces the longitudinal ends and thereby enables suppressing occurrence of the above problem. In the present embodiment, when the elastic valve body **3** is viewed from the bottom face **17**, the annular thick region **19** is formed in a manner to surround the slit **11** formed on the top face **12** and thickest at positions on the outer side in the longitudinal direction of the slit **11**. Such a configuration allows for preventing the ends of the slit **11** from being split and to ensure both of excellent insertability

of the male connector and maintenance of the elastic restoring force of the elastic valve body **3**.

A bottom face annular groove **21** is formed on the bottom face outer region **20** in a manner to surround the thick region **19**. A locking projection **31** (described later) of the bottom face cap **10** enters the bottom face annular groove **21** and compresses the elastic valve body **3** to constitute a part of the clamping section **32** (see FIGS. **2** and **3**).

As illustrated in FIGS. **4** to **5B**, an outer edge of the top face outer region **14** on the top face **12** and an outer edge of the bottom face outer region **20** on the bottom face **17** of the elastic valve body **3** are connected by a substantially circumferential side face **50** constituting an outer wall of the elastic valve body together with the top face **12** and the bottom face **17**.

[Top Face Cap **9**]

Hereinafter, configurations of the top face cap **9**, the bottom face cap **10**, and the holder **8** will be described with reference to FIGS. **1** to **3**.

As illustrated in FIGS. **2** and **3**, the top face cap **9** includes a substantially cylindrical hollow barrel **22** and a flange **23** which is formed on one end of the hollow barrel **22**. As illustrated in FIGS. **2** and **3**, an edge **24** is located on an upper face (upper faces in FIGS. **2** and **3**) positioned on the other end of the hollow barrel **22**. The edge **24** defines a substantially circular insertion opening that is one end of the insertion section **5**. A screw thread **25** is formed on the outer peripheral face of the hollow barrel **22** so as to be screwed with a lock connector defined by ISO 594. The flange **23** is a portion integrally molded with the hollow barrel **22**. The flange **23** is engaged with the holder **8** (described later) and thereby the top face cap **9** is held by the holder **8**.

As illustrated in FIGS. **2** and **3**, the locking projection **26** is formed on an inner wall of the hollow barrel **22** near the edge **24**. The locking projection **26** projects in the insertion direction B of the male connector **100** and enters the top face annular groove **15** of the elastic valve body **3** to compress the elastic valve body **3**. An inner wall **27** formed between the edge **24** and the locking projection **26** is in contact with the top face central region **13** of the elastic valve body **3** when the male connector **100** is not inserted and is in contact with the male connector **100** when the male connector **100** is inserted (see FIG. **9**, etc.). That is, when the male connector **100** is not inserted, the top face central region **13** is fitted into a space surrounded by the inner wall **27**. On the other hand, when the male connector **100** is inserted, the male connector **100** is fitted with the top face cap **9** through the cylindrical inner wall **27**. Although the inner wall **27** in the present embodiment has a cylindrical shape parallel to the insertion direction B, the inner wall **27** may have a tapered shape inner diameter of which is gradually reduced in the insertion direction B according to an outer shape of the male connector **100**. In the present embodiment, the male connector **100** is fitted with the top face cap **9** through the cylindrical inner wall **27** when the male connector **100** is inserted; however, configurations thereof are not limited thereto and the male connector **100** may not be in contact with the cylindrical inner wall **27** when the male connector **100** is inserted.

The upper face of the hollow barrel **22** includes the aforementioned edge **24** and a planar extending section **28** which surrounds the edge **24** and extends in a direction C perpendicular to the insertion direction B. When the top face central region **13** of the elastic valve body **3** is fitted into a space surrounded by the inner wall **27**, that is, when the male connector **100** is not inserted, the top face central region **13** of the elastic valve body **3** projects outward with respect to

the edge 24 and the extending section 28 in a removal direction D (direction opposite to the insertion direction B) of the male connector 100. Allowing the top face central region 13 of the elastic valve body 3 to project in the removal direction D in the above manner enables the entire top face central region 13 to be easily wiped off in a wiping operation for disinfection typically performed by a user immediately before insertion of the male connector 100. As a result, the valve body 3 can be maintained in a sanitary condition without germs, foreign substances, or the like left thereon. The top face central region 13 of the elastic valve body 3 and the extending section 28 of the top face cap 9 may be configured to form the same plane with the top face central region 13 of the elastic valve body 3 housed up to a position (height) of the edge 24 when the male connector 100 is not inserted.

[Bottom Face Cap 10]

Like the top face cap 9, as illustrated in FIGS. 2 and 3, the bottom face cap 10 includes a substantially cylindrical hollow barrel 29 and a flange 30 which is formed on one end of the hollow barrel 29. The other end of the hollow barrel 29 is formed with the locking projection 31 which projects in the removal direction D, compresses the elastic valve body 3 while entering the aforementioned bottom face annular groove 21 of the elastic valve body 3, and clamps the elastic valve body 3 together with the locking projection 26 of the top face cap 9. In this manner, the elastic valve body 3 is compressed and clamped by the clamping section 32 including the aforementioned locking projection 26 of the top face cap 9 and the locking projection 31 of the bottom face cap 10 and thereby positioned and fixed in the hollow section 4, specifically, in the insertion section 5.

The bottom face cap 10 is ultrasonic-bonded to the inner face of the hollow barrel 22 and/or the lower face (the lower face in FIGS. 2 and 3) of the flange 23 of the top face cap 9 and thereby held by the top face cap 9. Furthermore, the position of the bottom face cap 10 is fixed by supporting the flange 30 of the bottom face cap 10 by the holder 8 (described below).

[Holder 8]

As illustrated in FIGS. 2 and 3, the holder 8 supports the top face cap 9 and the bottom face cap 10 and defines the flow path 6 therein. In the present embodiment, the holder 8 are directly in contact with and thereby holds both of the top face cap 9 and the bottom face cap 10; however, for example, the holder 8 may not be in contact with the top face cap 9 but in direct contact with only the bottom face cap 10, thereby allowing the top face cap 9 to be in contact with the bottom face cap 10 and to be supported thereby. That is, the holder 8 may be in direct contact with and support one of the top face cap 9 and the bottom face cap 10 while not contacting the other. Preferably, members that are in direct contact are bonded by ultrasonic-bonding or the like, for example.

In the present embodiment, the top face cap 9 and the bottom face cap 10 clamps the elastic valve body 3 and thereby holds the elastic valve body 3 within the insertion section 5; however, for example, a holder integrally including the holder 8 and the bottom face cap 10 as in the present embodiment and the top face cap as in the present embodiment may compress and clamp the elastic valve body 3. That is, the housing of the connector is not limited to that including three members of a holder, a top face cap, and a bottom face cap but may be configured by two members out of the above members, for example. Furthermore, by adding another (other) member(s) to the above members, thereby configuring the housing by four or more members.

Next, detailed configuration of the holder 8 of the present embodiment will be described. As illustrated in FIGS. 2 and 3, the holder 8 of the present embodiment includes a substantially cylindrical outer barrel 34 which has a screw thread 33 for a lock connector formed on an inner peripheral face thereof, a male luer section 35, as an inner barrel, formed in a hollow section defined by an inner wall of the outer barrel 34, and a connection section 36 connecting the outer barrel 34 and the male luer section 35 at an end on the upstream side of the insertion direction B (downstream side of the removal direction D) of the outer barrel 34 and the male luer section 35. In the holder 8 of the present embodiment, an inner wall of the male luer section 35 and an inner wall of the connection section 36 define the flow path 6.

The flow path 6 defined by the holder 8 of the present embodiment includes a tubular flow path 37 defined by the inner wall of the male luer section 35 having a tapered shape where an inner diameter becomes smaller toward the downstream side of the insertion direction B and a connection flow path 38, defined by the connection section 36, positioned between the insertion section 5 and the tubular flow path 37 in the insertion direction B and connecting the insertion section 5 and the tubular flow path 37.

As illustrated in FIGS. 2 and 3, the inner wall of the housing 2 defining the flow path 6 is integrally formed with a liquid barrier face 39 which faces a tip opening 104 of the male connector 100 (see FIG. 9, etc.) inserted in the insertion section 5 in the insertion direction B and collides with liquid flowing out from the tip opening 104. In the present embodiment, an inner wall of the connection section 36 defining the connection flow path 38 of the flow path 6 is integrally formed with the liquid barrier face 39. That is, the liquid barrier face 39 itself is a part of the inner wall defining the flow path 6. Moreover, the liquid barrier face 39 is formed in the member itself having the inner wall defining the flow path 6.

In other words, the liquid barrier face 39 of the present embodiment is included in a partition section 40 of the housing 2. Specifically, the housing 2 of the present embodiment includes the partition section 40 dividing the flow path 6 in the direction C perpendicular to the insertion direction B and the liquid barrier face 39 includes an upstream face 41 (upper face in FIGS. 2 and 3) which is a face of the partition section 40 on the upstream side of the insertion direction B. More specifically, the holder 8 of the housing 2 of the present embodiment includes the partition section 40 dividing the connection flow path 38 into a plurality of separated flow paths (in the present embodiment, two separated flow paths) in the direction C perpendicular to the insertion direction B. The liquid barrier face 39 is formed by the upstream face 41 of the partition section 40.

The holder 8 of the housing 2 of the present embodiment includes the partition section 40 having the upstream face 41 as the liquid barrier face 39 as described above and thus liquid such as a liquid medicine supplied from the tip opening 104 (see FIG. 9, etc.) of the male connector 100 inserted in the insertion section 5 of the connector 1 into the flow path 6 of the connector 1 collides on the upstream face 41 as the liquid barrier face 39, thereby generating a turbulence flow in the flow path 6. This allows for suppressing continuous stagnation of liquid such as liquid medicine in the hollow section 4 of the connector 1. The configuration of the partition section 40 will be described in detail later (see FIGS. 6 to 8, etc.).

As illustrated in FIGS. 2 and 3, the inner wall, defining the flow path 6, of the housing 2 of the present embodiment includes a tip receiving face 42 to receive the tip 101 (see

FIGS. 9 to 11) of the male connector 100. The tip receiving face 42 receives the tip 101 of the male connector 100 inserted from the outside through the slit 11 of the elastic valve body 3 and thereby prevents the male connector 100 from being excessively inserted into the connector 1 in the insertion direction B of the male connector.

More specifically, the tip receiving face 42 of the present embodiment is integrally formed with the inner wall of the holder 8 defining the connection flow path 38. The tip receiving face 42 of the present embodiment is positioned on the upstream side with respect to the upstream face 41 in the insertion direction B. Therefore, when the tip 101 of the male connector 100 inserted in the insertion section 5 is received by the tip receiving face 42, a space is formed between the tip opening 104 of the male connector 100 and the upstream face 41 of the partition section 40. As illustrated in FIG. 3, the tip receiving face 42 of the present embodiment is integrally formed with the aforementioned upstream face 41 of the partition section 40 in a continuous manner. Details of the tip receiving face 42 will be described later (see FIGS. 9 to 11, etc.).

[Partition Section 40]

Next, detailed configuration of the partition section 40 will be described. FIG. 6 is a cross-sectional perspective view of the holder 8 alone illustrating the same cross section as that of the connector 1 illustrated in FIG. 2. Moreover, FIG. 7 is a cross-sectional perspective view of the holder 8 alone illustrating the same cross section as that of the connector 1 illustrated in FIG. 3. Furthermore, FIG. 8 is a top view of the holder 8 seen from the insertion direction B. For convenience of description, a round two-dot chain line illustrated in FIG. 8 represents the position of the edge 24 of the top face cap 9 attached to the holder 8. Hereinafter, the partition section 40 will be described in detail with reference to FIGS. 2, 3, and 6 to 8.

As described above, the upstream face 41 of the partition section 40 forms the aforementioned liquid barrier face 39 and the partition section 40 divides the flow path 6 in the direction C perpendicular to the insertion direction B. As illustrated in FIGS. 6 to 8, the partition section 40 of the present embodiment extends to connect opposite inner walls in the direction C perpendicular to the insertion direction B and divides the flow path 6 into two separated flow paths in a direction perpendicular to the opposing direction of the opposite inner walls out of the directions C perpendicular to the insertion direction B. More specifically, the partition section 40 of the present embodiment divides the connection flow path 38 of the flow path 6 into a first connection flow path 43 and a second connection flow path 44 separated from each other. Liquid flowing out from the tip opening 104 (see FIG. 9, etc.) of the male connector 100 inserted in the insertion section 5 is bifurcated by the partition section 40, passes through the first connection flow path 43 and the second connection flow path 44, and then joins in the tubular flow path 37.

The partition section 40 of the present embodiment has a plate shape and includes the upstream face 41 as the liquid barrier face 39, a downstream face 45 which is the opposite face of the upstream face 41 (face on the downstream side in the insertion direction B), and a side face 46 connecting the upstream face 41 and the downstream face 45.

In the present embodiment, both of the upstream face 41 and the downstream face 45 are planes extending in the direction C perpendicular to the insertion direction B. In the present embodiment, therefore, when the male connector 100 is inserted in the insertion section 5, the liquid flowing out from the tip opening 104 of the male connector 100

collides on the upstream face 41 (liquid barrier face 39) and then flows in the direction C perpendicular to the insertion direction B along the planar upstream face 41. As a result, the liquid flowing out from the tip opening 104 easily reaches an inner wall defining the connection flow path 38 positioned around the partition section 40 in the direction C perpendicular to the insertion direction B. This allows for forming a flow of liquid in such a manner as to follow along the inner wall defining the flow path 6, thereby further mitigating continuous stagnation of liquid in the hollow section 4.

Furthermore, the upstream face 41 as the liquid barrier face 39 is included at a position overlapping with the insertion opening, defined by the inner wall of the housing 2, which is the end of the insertion section 5 when seen from the insertion direction B of the housing 2. Specifically, as illustrated in FIG. 8, the upstream face 41 is included at a position overlapping with the insertion opening (opening, defined by the edge 24, illustrated by the two-dot chain line in FIG. 8) that is the end of the insertion section 5. Especially in the present embodiment, the entire region of the upstream face 41 is positioned on the inner side with respect to the insertion opening that is the end of the insertion section 5 when the housing 2 is seen from the insertion direction B. Furthermore, the upstream face 41 is positioned to overlap at least with the central region of the insertion opening (see FIG. 8). Positioning the upstream face 41 at such a position allows the upstream face 41 to face the tip opening 104 (see FIGS. 9 to 11) of the male connector 100 inserted from the outside in the insertion direction B. In other words, the upstream face 41 of the present embodiment is positioned on the upstream side with respect to the tubular flow path 37 in the insertion direction B.

The phrase “when the housing 2 is seen from the insertion direction B” refers to a case where an object is projected on a virtual plane when the housing 2 is seen from the insertion direction B and does not mean whether visual inspection is actually possible. Therefore, the above relation between the upstream face 41 and the insertion opening refers to a case where the upstream face 41 and the inner wall of the housing 2 (in the present embodiment, the edge 24) defining the insertion opening are projected on a virtual plane when the housing 2 is seen from the insertion direction B.

Furthermore in the present embodiment, when the housing 2 including the holder 8, the top face cap 9, and the bottom face cap 10 is seen from the insertion direction B, the maximum width $W1_{max}$ of a width $W1$ of the partition section 40 interposed between the flow paths 6 is smaller than an internal diameter d of the housing 2 defining the insertion opening that is the end of the insertion section 5. More specifically, as illustrated in FIG. 2, the maximum width $W1_{max}$ of the partition section 40 interposed between the first connection flow path 43 and the second connection flow path 44 is smaller than the internal diameter d of the edge 24 of the top face cap 9.

Moreover, as illustrated in FIG. 2, the maximum width $W2_{max}$ of a width $W2$ of the inner wall defining the connection flow path 38 in the direction C perpendicular to the insertion direction B is larger than the internal diameter d of the housing 2 defining the insertion opening that is the end of the insertion section 5. That is, in the present embodiment, an inequality $W1_{max} < d < W2_{max}$ holds. According to the connector 1 of the present embodiment, therefore, the partition section 40 included in the housing 2 generates a turbulence flow of liquid, thereby allowing for mitigating continuous stagnation of the liquid in the hollow section 4. Also, since relatively large spaces are ensured for

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the flow paths (in the present embodiment, the first connection flow path **43** and the second connection flow path **44**) positioned in the direction C perpendicular to the insertion direction B with respect to the partition section **40**, a flow rate per unit time of the liquid flowing in the flow path **6** tends not to be limited by the partition section **40**. The above maximum width W_{2max} is positioned in the direction C perpendicular to the insertion direction B with respect to the partition section **40** and refers to the maximum distance between the inner walls opposite to each other interposing the flow paths **6** (in the present embodiment, the first connection flow path **43** and the second connection flow path **44**) and the partition section **40** in the direction C.

As illustrated in FIG. **8**, the partition section **40** of the present embodiment has a substantially round-shaped outer shape when seen from the insertion direction B. That is, the upstream face **41** and the downstream face **45** of the present embodiment are planes having a substantially round-shaped outer shape of the same outer diameter. A side face **46** connects outer edges of the upstream face **41** and the downstream face **45** and is an arc-shaped curved face when seen from the insertion direction B. Therefore, the above the maximum width W_{1max} of the present embodiment is equivalent to an outer diameter of the partition section **40**, that is, an outer diameter of the upstream face **41** or the downstream face **45** when seen from the insertion direction B.

The partition section **40** of the present embodiment extends to connect the opposite inner walls in the direction C perpendicular to the insertion direction B and forms the two separated flow paths in a direction perpendicular to the opposing direction of the opposite inner walls out of the directions C perpendicular to the insertion direction B. However, for example, a partition section may protrude from one side toward the other side of the opposite inner walls in the direction C perpendicular to the insertion direction B and may not be connected to the other side where apart of the partition section is connected in the direction C perpendicular to the insertion direction B, thereby forming one flow path. Moreover, the partition section **40** of the present embodiment extends to connect opposite inner walls in the direction C perpendicular to the insertion direction B; however, the positions where the partition section **40** extends from and to are not limited thereto and, for example, a partition section may extend to connect inner walls that are not opposite to each other in the direction C perpendicular to the insertion direction B. Furthermore, the number of flow paths separated by the partition section is not limited to two and a partition section may divide a flow path into three or more flow paths separated from each other.

The upstream face **41** of the present embodiment is a plane extending in the direction C perpendicular to the insertion direction B. However, the upstream face is not limited to such a plane as long as a shape thereof facilitates formation of a flow of liquid in such a manner as to follow along an inner wall defining the flow path **6**. Therefore, for example, an upstream face **41** may be a plane inclined by a predetermined angle with respect to the direction C perpendicular to the insertion direction B or may be a curved face bent toward the insertion direction B or the removal direction D. Note that it is especially preferable that, like in the present embodiment, the upstream face **41** of the partition section **40** is a plane extending in the direction C perpendicular to the insertion direction B. This allows for facilitating formation of a flow of liquid in such a manner as to follow along an inner wall defining the flow path **6** as well

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as suppressing stagnation of liquid such as liquid medicine on the upstream face **41** after use of the connector **1**, for example.

The downstream face **45** of the partition section **40** of the present embodiment is a plane extending in the direction C perpendicular to the insertion direction B and the side face **46** is a curved face without an inflection point; however, the downstream face or the side face is not limited thereto. Note that configuring the respective faces included in the outer wall by planes or curved faces without inflection points like the partition section **40** of the present embodiment results in not forming a part prone to stagnation of liquid on the respective faces such as a corner between a groove wall and a groove bottom, thereby further suppressing stagnation of liquid on the respective faces.

Moreover, as illustrated in FIG. **8**, the partition section **40** of the present embodiment is a round flat plate having a substantially round-shaped outer shape when seen from the insertion direction B; however, the partition section **40** is not limited thereto. For example, the partition section **40** may have a columnar shape such as a rectangular parallelepiped or a cube having two linear lines, parallel to each other when seen from the insertion direction B, as a contour of an outer edge. Alternatively, the partition section may be a combination of a plurality of three-dimensional shapes. For example, a partition section may be formed of a columnar round flat plate section having a liquid barrier face and a plurality of rod-shaped sections which extends from a side face of the round flat plate section toward a radial direction and connects an inner wall of a flow path positioned around the round flat plate section with the round flat plate section. The above the maximum width W_{1max} of the partition section having such a configuration is equivalent to an outer diameter of the round flat plate section.

FIG. **13** is a diagram illustrating a partition section **60** as a modification of the partition section **40** of the present embodiment. FIG. **13** is an enlarged cross-sectional view of the partition section **60** in the same cross section as that in FIG. **2**. An upstream face **61** as a liquid barrier face **39** of the partition section **60** illustrated in FIG. **13** expands from an apex **62** on the removal direction D side toward the insertion direction B and has a side face shape of a cone formed by an inclined face **64** where an end on the insertion direction B side communicates with a side face **63**. Such a shape of the upstream face **61** facilitates liquid such as liquid medicine colliding on the upstream face **61** to be guided into a connection flow path **38** along the inclined face **64** as compared to the upstream face **41** of the partition section **40** of the present embodiment. That is, on the upstream face **61**, including the inclined face **64** inclined toward the connection flow path **38** descending from the upstream side to the downstream side of the insertion direction B facilitates ensuring a flow rate per unit time of liquid flowing from an insertion section **5** side toward a tubular flow path **37**, thereby allowing for shortening time required for removal of liquid stagnating in a hollow section **4**. The upstream face **61** illustrated in FIG. **13** has no convex curved portion toward the insertion direction B, thereby suppressing stagnation of liquid such as liquid medicine on the upstream face **61** after use of a connector **1**, for example.

Moreover, a downstream face **65** of the partition section **60** illustrated in FIG. **13** expands from an apex **66** on the insertion direction B toward the removal direction D and has a side face shape of a cone formed by an inclined face **67** where an end on the removal direction D side communicates with the side face **63**. Such a shape of the downstream face **65** allows for mitigating stagnation of liquid on the down-

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stream face **65** as compared to the downstream face **45** of the partition section **40** of the present embodiment.

The upstream face **61** of the partition section **60** illustrated in FIG. **13** is integrally formed with an inner wall defining the connection flow path **38** as the flow path **6** like the upstream face **41** of the partition section **40** of the present embodiment. Specifically, the upstream face **61** is integrally formed with a tip receiving face **42** defining the connection flow path **38**. More specifically, the upstream face **61** is integrally formed with the tip receiving face **42** via a step face **68** integrally formed with the tip receiving face **42** in a continuous manner.

The partition section **60** illustrated in FIG. **13** has different shapes of the upstream face **61** and a downstream face **65** as compared to those of the partition section **40** of the present embodiment. However, other configurations are similar.

FIG. **14** is a diagram illustrating of a partition member **70** having a similar shape to that of the partition section **60** illustrated in FIG. **13**. More specifically, FIG. **14** is an enlarged cross-sectional view illustrating the enlarged partition member **70** at a similar cross section to that in FIG. **2** of a connector **1000** attached with the partition member **70**. The partition member **70** illustrated in FIG. **14** is attached to a support section **71** of a rib shape integrally formed with an inner wall defining a connection flow path **3800** as a flow path **600** and thereby supported by the support section **71**. The partition member **70** illustrated in FIG. **14** is formed with a cut-away section **73**, where the support section **71** enters, at a position opposite to the side face **72** (in the example illustrated in FIG. **14**, position opposite in a direction perpendicular to the paper face). The cut-away section **73** extends from an upstream face **74** to a downstream face **75** and includes an upstream side cut-away section **73a** on the upstream face **74** side and a downstream side cut-away section **73b** which communicates with the upstream side cut-away section **73a** via a step face **76** and has a larger width than that of the upstream side cut-away section **73a** in the direction C perpendicular to the insertion direction B. The support section **71** has a shape corresponding to the cut-away section **73** and an end thereof on the removal direction D side includes a tip receiving face **77** to receive a tip **101** (see FIG. **9**, etc.) of the male connector **100**. The support section **71** includes a first fitting section **71a** which fits into the upstream side cut-away section **73a** and a second fitting section **71b** which fits into the downstream side cut-away section **73b** and has a larger width than that of the first fitting section **71a** in the direction C perpendicular to the insertion direction B. A step face **78** between an outer face of the first fitting section **71a** and an outer face of the second fitting section **71b** abuts against the step face **76** of the cut-away section **73** and thereby limits further movement of the attached partition member **70** in the insertion direction B. That is, the partition member **70** is positioned with respect to the support section **71** in the insertion direction B with the step face **76** of the partition member **70** abutting against the step face **78** of the support section **71**.

FIG. **15** is a diagram illustrating a modification of the liquid barrier face **39** of the present embodiment. Specifically, FIG. **15** is a diagram illustrating a connector **1** including a projecting wall section **80** instead of the partition section **40** as well as an enlarged cross-sectional view of the projecting wall section **80** at the same cross section as that in FIG. **3**. FIG. **16** is a cross-sectional perspective view, of a holder **8** alone including the projecting wall section **80**, illustrating the same cross section as that of the connector **1** illustrated in FIG. **3**. The projecting wall section **80** illustrated in FIGS. **15** and **16** is integrally formed with an inner

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wall defining a flow path **6** and projects inward (in FIG. **15**, toward the central axis O of a tubular flow path **37**) from the surrounding inner wall positioned in the direction C perpendicular to the insertion direction B. In other words, a housing **2** (see FIG. **2**, etc.) includes the projecting wall section **80** projecting inward from the surrounding inner wall positioned in the direction C perpendicular to the insertion direction B.

As illustrated in FIG. **15**, the projecting wall section **80** includes an upstream face **81** as a liquid barrier face **39**, a side face **82** communicating with an edge of the upstream face **81** on the flow path **6** side and extending in the insertion direction B, and a downstream face **83** communicating with an end of the side face **82** in the insertion direction B and formed by an inclined face expanding outward in the radial direction of the flow path **6** in the insertion direction B.

The upstream face **81** as the liquid barrier face **39** of the projecting wall section **80** is a face of the projecting wall section **80** on the upstream side in the insertion direction B, that is, a face on the removal direction D side of the projecting wall section **80**. The upstream face **81** includes a planar section **84** extending in the direction C perpendicular to the insertion direction B and a rib-shaped projection **85** integrally formed with the planar section **84** and projecting from the planar section **84** in the removal direction D.

The planar section **84** illustrated in FIGS. **15** and **16** is integrally formed with a tip receiving face **42** to receive a tip **101** (see FIG. **9**, etc.) of a male connector **100** via a step face **86**.

As illustrated in FIG. **16**, the tip receiving face **42** is formed at a part of an inner wall defining a flow path **6** in a circumferential direction E around the central axis O. The tip receiving face **42** projects inward of the flow path **6** than other parts in the circumferential direction E. In other words, of the inner wall defining the flow path **6**, a part adjacent to the tip receiving face **42** in the circumferential direction E is a diameter expansion face **87** positioned outward in the radial direction of the flow path **6** than the tip receiving face **42** via the step. As illustrated in FIGS. **15** and **16**, the tip receiving faces **42** are included at opposite positions interposing the flow path **6**. The diameter expansion faces **87** are arranged opposite to each other interposing the flow path **6**, of the directions C perpendicular to the insertion direction B, in a direction perpendicular to the opposing direction of the two tip receiving faces **42**. In other words, the diameter expansion faces **87** are positioned between the two opposite tip receiving faces **42** in the circumferential direction E. The diameter expansion face **87** may be formed as a reduced thickness portion, for example. As illustrated in FIG. **16**, the opposite diameter expansion faces **87** have a bent tapered shape where an opposing distance in the direction C perpendicular to the insertion direction B gradually decreases in the insertion direction B. An end of the diameter expansion face **87** in the insertion direction B is communicated with an inner wall defining a tubular flow path **37**.

The rib-shaped projection **85** illustrated in FIGS. **15** and **16** extends, of the directions C perpendicular to the insertion direction B, in the direction perpendicular to the opposing direction of the tip receiving faces **42**. In other words, the rib-shaped projection **85** extends in the opposing direction of the opposing diameter expansion faces **87**. Both ends of the rib-shaped projection **85** in the extending direction are integrally formed with the diameter expansion faces **87** in a continuous manner.

Therefore, as illustrated in FIGS. **15** and **16**, the planar section **84** of the upstream face **81** forms a bottom section of a concave section defined by a face of the rib-shaped

projection **85** on the outer side in the radial direction of the flow path **6**, the tip receiving face **42**, the step face **86** communicating with the tip receiving face **42**, and the diameter expansion faces **87** opposite to each other.

When the male connector **100** is inserted in the connector **1**, the tip receiving face **42** directly or indirectly receives the tip **101** of the male connector **100**, thereby positioning the male connector **100** in the insertion direction B. In a state where the male connector **100** is positioned by the tip receiving face **42**, a space is formed between the male connector **100** and the diameter expansion face **87**.

The side face **82** of the projecting wall section **80** extends in the insertion direction B to smoothly communicate with a face of the rib-shaped projection **85** on the inner side in the radial direction of the flow path **6**.

Including such a projecting wall section **80** allows liquid flowing in from the tip **101** of the male connector **100** connected to the connector **1** collides on the upstream face **81** as the liquid barrier face **39** and then generates a turbulence flow. Specifically, as illustrated by arrows in FIG. **16**, a flow is formed where the liquid flows from the planar section **84** interposed between the rib-shaped projection **85** and the step face **86**, passes through the space formed between the male connector **100** and the diameter expansion face **87**, then flows along the diameter expansion face **87** in the circumferential direction E, climbs over the rib-shaped projection **85** of the projecting wall section **80**, and flows in the insertion direction B toward the tubular flow path **37**. That is, since a flow along the inner wall defining the hollow section **4** of the connector **1** is formed, continuous stagnation of liquid in the hollow section **4** can be mitigated.

Furthermore, the connector **1** illustrated in FIGS. **15** and **16** includes, at a position adjacent to the tip receiving face **42** in the circumferential direction E, the diameter expansion face **87** on the outer side than the tip receiving face **42** in the radial direction. This allows liquid to flow through the position on the outer side in the radial direction where liquid is prone to stagnation, thereby further suppressing stagnation of liquid in the hollow section **4**.

The downstream face **83** of the projecting wall section **80** illustrated in FIGS. **15** and **16** is an inclined face inclined toward the insertion direction B. Therefore, as compared to a case of a plane perpendicular to the insertion direction B, liquid tends not to stagnate on the downstream face **83**.

The upstream face **81** of the projecting wall section **80** illustrated in FIGS. **15** and **16** collides only with a part of the liquid flowing in from the tip **101** of the male connector **100** inserted in the connector **1**. That is, when the projecting wall section **80** is seen from the insertion direction B, an area of the projecting wall section **80** is smaller than an area of the partition section **60** illustrated in FIG. **13**. Thus, a part of the liquid flowing in from the tip **101** of the male connector **100** inserted in the connector **1** flows toward the tubular flow path **37** without colliding on the upstream face **81**. Therefore, with the projecting wall section **80** illustrated in FIGS. **15** and **16**, it is further easier to secure a flow rate per unit time of liquid flowing from the insertion section **5** side toward the tubular flow path **37** as compared to the partition section **60** illustrated in FIG. **13**. Especially, the projecting wall section **80** illustrated in FIGS. **15** and **16** is not arranged on the central axis O of the tubular flow path **37** when the connector **1** is seen from the insertion direction B. Therefore, the projecting wall section **80** is arranged in a projecting manner such that the projecting wall section **80** and the tip opening **104**, (see FIG. **9**, etc.) of the male connector **100** inserted such that the central axis thereof and the central axis O of the tubular flow path **37** substantially matches, overlap

with each other at a different position from the central axis O when seen from the insertion direction B. Therefore, the projecting wall section **80** has a configuration that further facilitates securing a flow rate per unit time of liquid flowing from the insertion section **5** side toward the tubular flow path **37**. Furthermore, the projecting wall section **80** illustrated in FIGS. **15** and **16** can be molded by one mold and thus is advantageous in the point that a mold structure can be simplified.

FIG. **17** is a diagram illustrating another modification of the liquid barrier face **39** of the present embodiment. Specifically, FIG. **17** is a diagram illustrating a connector **1** including an annular flange **90** instead of the partition section **40** as well as an enlarged cross-sectional view of the annular flange **90** at the same cross section as that in FIG. **3**. The annular flange **90** projects from an inner peripheral face of a flow path **6** toward the inner side of the flow path **6** in the direction C perpendicular to the insertion direction B and is integrally formed with an inner wall defining the flow path **6**. In other words, a housing **2** (see FIG. **2**, etc.) includes the annular flange **90** projecting toward the inner side of the flow path **6**. An upstream face **91** as a liquid barrier face **39** of the annular flange **90** is a face of the annular flange **90** on the upstream side in the insertion direction B. The upstream face **91** includes a planar section **92** extending in the direction C perpendicular to the insertion direction B and an annular rib **93** projecting from an inner edge of the planar section **92** in the removal direction D. Since the upstream face **91** includes the annular rib **93**, liquid flowing in from a tip **101** of an inserted male connector **100** and colliding on the planar section **92** is limited of a flowing direction by the annular rib **93** and thus tends to flow in the circumferential direction E along an inner wall defining the flow path **6**. That is, since a flow along the inner wall defining the flow path **6** is formed, continuous stagnation of liquid in the hollow section **4** can be mitigated.

A tip receiving face **42** illustrated in FIG. **17** has the same configuration as those illustrated in FIGS. **15** and **16**. Moreover, preferably, an inner wall of a part adjacent to the tip receiving face **42**, illustrated in FIG. **17**, in the circumferential direction E is positioned outward in the radial direction of the flow path **6** than the tip receiving face **42** like the diameter expansion face **87** illustrated in FIGS. **15** and **16**.

[Connector **1** where Male Connector **100** is Inserted from Outside]

In the above, descriptions have been provided mainly on the configurations of the connector **1** where the male connector **100** is not inserted from the outside as illustrated in FIGS. **1** to **8**. Hereinafter, the connector **1** where the male connector **100** is inserted in the insertion section **5** from the outside will be described. FIG. **9** is a cross-sectional view, of a connector **1** inserted with a male connector **100**, illustrating the same cross section as that illustrated in FIG. **2**. FIG. **10** is a cross-sectional view, of the connector **1** inserted with the male connector **100**, illustrating the same cross section as that illustrated in FIG. **3**. FIG. **11** is an enlarged cross-sectional view where a tip **101** and the vicinity thereof of the male connector **100** are enlarged from FIG. **10**.

First, the male connector **100** inserted into the connector **1** will be described. The male connector **100** has a shape defined by ISO 594 with an outer diameter of a cross section perpendicular to the insertion direction B of the male connector gradually decreasing by 6% for every 1 mm toward a tip **101** in a tapered manner. More specifically, the male connector **100** can be formed of the same material as that of the aforementioned housing **2**. When the male

connector **100** is formed of a rigid material, a diameter of the tip is within a range of 3.925 mm to 3.990 mm. When the male connector **100** is formed of a semi-rigid material, a diameter of the tip is within a range of 3.925 mm to 4.027 mm. The length of the male connector **100** is 7.50 mm or more.

When the male connector **100** is inserted into the insertion section **5** (see FIG. 2, etc.) of the connector **1**, the tip **101** of the male connector **100** elastically deforms the elastic valve body **3** in a pushing manner toward the inner side of the connector **1** and reaches the flow path **6** in the holder **8** via the slit **11**. That is, in the present embodiment, in a state illustrated in FIGS. 9 to 11, a flow path **103** in the male connector **100** is directly communicating with the flow path **6** of the holder **8**.

The elastic valve body **3** is elastically deformed by the inserted male connector **100**, enters between the inner wall of the bottom face cap **10** and an outer wall of the male connector **100**, and is tightly attached to an outer face of the male connector **100**. This suppresses leakage of liquid from the insertion section **5** of the connector **1** to the outside.

As illustrated in FIG. 10, the tip **101** of the male connector **100** abuts against the tip receiving face **42** provided to the inner wall defining the connection flow path **38** of the inner wall of the holder **8** while interposing the elastic valve body **3**, thereby positioning the male connector in the insertion direction B. More specifically, as illustrated in FIG. 11, the tip **101** of the male connector **100** includes a tip peripheral face **101a** forming the outer wall of the male connector in the direction C perpendicular to the insertion direction B, a tip plane **101b** defining a tip opening **104** of the flow path **103** in the male connector **100** and forming the outer wall of the male connector in the insertion direction B, and a tip curved face **101c** having an arc-shaped cross section and connecting the tip peripheral face **101a** and the tip plane **101b** in the cross-sectional view in FIGS. 9 to 11. The tip curved face **101c** of the tip **101** of the male connector **100** presses the tip receiving face **42** via the elastic valve body **3**, thereby limiting insertion of the male connector **100** in the insertion direction B and positioning the tip **101** of the male connector **100** in the insertion direction B.

In the present embodiment, the tip receiving face **42** receives the tip curved face **101c** of the male connector **100** via the elastic valve body **3**; however, the tip receiving face **42** may receive the tip peripheral face **101a** or the tip plane **101b** instead of the tip curved face **101c** of the male connector **100** or in addition to the tip curved face **101c**. Moreover, in the present embodiment, the tip receiving face **42** receives the tip **101** of the male connector **100** via the elastic valve body **3**; however, the tip receiving face **42** may receive the tip **101** by directly contacting one of the faces of the tip **101** of the male connector **100** without interposing the elastic valve body **3**.

As illustrated in FIGS. 10 and 11, when the tip receiving face **42** receives the tip **101** of the male connector **100**, the tip **101** of the male connector **100** and the upstream face **41** (liquid barrier face **39**) of the partition section **40** are not in contact. That is, when the male connector **100** is received by the tip receiving face **42**, the upstream face **41** (liquid barrier face **39**) is positioned on the downstream side in the insertion direction B than the tip receiving face **42** so that the tip plane **101b** of the male connector **100** does not contact with the upstream face **41** of the partition section **40**. More specifically, the upstream face **41** of the present embodiment is a plane extending in the direction C perpendicular to the insertion direction B. The tip receiving face **42** is a curved face having, in the cross-sectional views in FIGS. 10 and 11,

a linear cross section communicating with both ends of the upstream face **41** and having a predetermined angle in the direction C perpendicular to the insertion direction B.

That is, the tip receiving face **42** of the present embodiment includes two curved faces (linear lines in the cross-sectional views in FIGS. 10 and 11) opposite to each other in the direction C perpendicular to the insertion direction B. These two curved faces are formed in a tapered manner as illustrated in FIGS. 10 and 11 where the opposing distance in the direction C perpendicular to the insertion direction B decreases in the insertion direction B. An end of each of the two curved faces on the downstream side in the insertion direction B is communicated with the upstream face **41**. Therefore, even when the tip receiving face **42** receives the tip **101** of the male connector **100**, a space is formed between the tip plane **101b** of the male connector **100** and the upstream face **41** (liquid barrier face **39**) of the partition section **40** in the insertion direction B. The tip plane **101b** of the male connector **100** therefore does not contact with the upstream face **41** of the partition section **40**. Such a configuration prevents the upstream face **41** of the partition section **40** from blocking the tip opening **104** of the male connector **100** even when liquid such as liquid medicine is supplied from the tip opening **104** of the inserted male connector **100** into the connector **1**. This allows for mitigating resistance of injection of liquid supplied from the male connector **100**.

Next, a flow of liquid in the connector **1** will be described with reference to FIG. 9 where liquid such as liquid medicine is supplied from the tip opening **104** of the male connector **100** into the connector **1** while the tip receiving face **42** receives the tip **101** of the male connector **100**. In FIG. 9, the flow of liquid in the connector **1** is illustrated by arrows.

Liquid flowing out from the tip opening **104** of the male connector **100** enters the connection flow path **38** of the flow path **6** and first collides on the upstream face **41** of the partition section **40** (liquid barrier face **39**) as described above. The liquid collided on the upstream face **41** then proceeds along the upstream face **41** in the direction C perpendicular to the insertion direction B. In the present embodiment, the tip receiving face **42** is communicated with the upstream face **41** and the tip receiving face **42** receives the tip **101** of the male connector **100**. Therefore, the liquid proceeding along the upstream face **41** flows toward the first connection flow path **43** and the second connection flow path **44** in the direction C perpendicular to the insertion direction B. Thereafter, the liquid passes through the first connection flow path **43** and the second connection flow path **44** and then flows into the tubular flow path **37**.

The liquid flowing along the upstream face **41** toward the first connection flow path **43** and the second connection flow path **44** is pushed out with a rush from the outer edge of the upstream face **41** to the outside of the upstream face **41** in the direction C perpendicular to the insertion direction B. The liquid pushed out from the upstream face **41** thus reaches the opposite inner walls of the holder **8** (inner walls defining the connection flow path **38**) interposing the first connection flow path **43**, the second connection flow path **44**, and the partition section **40** in the direction C perpendicular to the insertion direction B and forms a flow along these inner walls. As illustrated by the arrows in FIG. 9, the liquid having reached the inner walls defining the connection flow path **38** is bifurcated into a flow that enters into a space formed between the elastic valve body **3** and the housing **2** (see FIG. 2, etc.), specifically, the holder **8** and the inner wall of the bottom face cap **10** along these inner walls,

and a flow that flows toward the first connection flow path **43** and the second connection flow path **44** along these inner walls. Most of the liquid flows into the tubular flow path **37** according to the latter flow.

As described above, the elastic valve body **3** is elastically deformed by the inserted male connector **100**, enters between the inner wall of the bottom face cap **10** and the outer wall of the male connector **100**, and is tightly attached to the outer face of the male connector **100**. However, for example with an object of mitigating resistance of insertion of the male connector inserted from the outside, there are cases where a wide space capable of accommodating an elastic valve body is ensured between an inner wall of a housing such as a bottom face cap **10** and an outer wall of a male connector. In this case, although restoring force of the elastic valve body allows the elastic valve body to be tightly attached to the outer wall of the male connector, the elastic valve body may not be tightly attached to the inner wall of the housing. Other than the object of mitigating resistance of insertion, the elastic valve body may not be tightly attached to the inner wall of the housing due to attachment accuracy of the elastic valve body or dimensional tolerances of members included in the connector, for example. In such a case, liquid flowing out from the tip opening of the male connector where the male connector is inserted may enter a space formed at the aforementioned portion without tight attachment and continuously stagnate thereat. Furthermore, depending on a type of the liquid, continuous stagnation may result in of microbial growth.

Therefore in the present embodiment, as described above, the flow of liquid to follow the inner wall defining the connection flow path **38** is formed and, even if there is a space between the outer wall of the elastic valve body **3** and the inner walls of the holder **8** and the bottom face cap **10**, the liquid is intentionally caused to enter the space. The liquid entering the space between the outer wall of the elastic valve body **3** and the inner walls of the holder **8** and the bottom face cap **10**, for example, pushes, out of the space, liquid having entered the space to the connection flow path **38**. This replaces liquid in the space, thereby suppressing continuous stagnation of the liquid in the space. The liquid having entered the space may be pushed out to the connection flow path **38** again from a position where the liquid have entered the space or a vicinity thereof; however, for example as illustrated in FIGS. **10** and **11**, the liquid may pass through a tubular space surrounded by the tip receiving face **42**, the elastic valve body **3**, the holder **8**, and the bottom face cap **10** to move in a circumferential direction having the insertion direction B in the center and is pushed out from a position different from the position where the liquid have entered the space or the vicinity thereof.

In this manner, the connector **1** of the present embodiment includes the partition section **40** including the upstream face **41** as the liquid barrier face **39** and thus is capable of suppressing generation of a turbulence flow of liquid in the flow path **6** and continuous stagnation of the liquid in the housing **2** (see FIG. **2**, etc.).

[Infusion Set **110** Including Connector **1**]

Lastly, an infusion set **110** including the connector **1** as an embodiment of the present invention will be described. FIG. **12** is a diagram illustrating the infusion set **110**.

The infusion set **110** forms an infusion line connecting from a first medical device, such as a syringe, having the male connector **100** to a second medical device such as an indwelling needle. Specifically, the infusion set **110** of the present embodiment includes a connector **1** to which the first medical device having a male connector such as a syringe is

connected, a plurality of infusion solution tubes **111**, a roller clamp **112** which adjusts a flow rate of liquid such as an infusion solution inside the infusion solution tube **111**, an air vent filter **113** which discharges (or supplies) air present in the infusion line, and a clamp **114** which blocks the infusion solution tube **111**.

In the present embodiment, the connector **1** is included at the position connecting the male connector with the first medical device; however, the position of the connector **1** is not limited thereto. For example regarding the infusion line as illustrated in FIG. **12** as a main line, a sub-line capable of mixture injection of other liquid medicine may be provided to the main line where the connector **1** may be provided to the sub-line as a mixture injection port.

Furthermore, the infusion set **110** of the present embodiment includes the connector **1**, the infusion solution tubes **111**, the roller clamp **112**, the air vent filter **113**, and the clamp **114**; however, members to configure the infusion set is not limited thereto and may be changed as appropriate according to an object or usage of the infusion set such as further including a drip infusion cylinder or a T-shaped connector for mixture injection in addition to the above members.

The present invention is not limited to the configurations specified in the above embodiments but may include various modifications within a scope not departing from the principals of the invention described in the claims.

The term "top face cap" used herein refers to the cap in contact with the top face of the elastic valve body. Likewise, the term "bottom face cap" refers to the cap in contact with the bottom face of the elastic valve body.

INDUSTRIAL APPLICABILITY

The present disclosure relates to a connector and an infusion set. In particular, the disclosure invention relates to a connector that is capable of connecting thereto a male connector and an infusion set using the connector.

REFERENCE NUMERAL LIST

- 1** connector
- 2** housing
- 3** elastic valve body
- 4** hollow section
- 5** insertion section
- 6** flow path
- 7** cap
- 8** holder
- 9** top face cap
- 10** bottom face cap
- 11** slit
- 12** top face of elastic valve body
- 13** top face central region
- 14** top face outer region
- 15** top face annular groove
- 16** side wall
- 17** bottom face of elastic valve body
- 18** bottom face central region
- 19** thick region
- 20** bottom face outer region
- 21** bottom face annular groove
- 22** hollow barrel of top face cap
- 23** flange of top face cap
- 24** edge
- 25** screw thread
- 26** locking projection of top face cap

27 inner wall
 28 extending section
 29 hollow barrel of bottom face cap
 30 flange of bottom face cap
 31 locking projection of bottom face cap
 32 clamping section
 33 screw thread
 34 outer barrel
 35 male luer section
 36 connection section
 37 tubular flow path
 38 connection flow path
 39 liquid barrier face
 40 partition section
 41 upstream face of partition section
 42 tip receiving face
 43 first connection flow path
 44 second connection flow path
 45 downstream face of partition section
 46 side face of partition section
 50 side face of elastic valve body
 60 partition section
 61 upstream face
 62 apex
 63 side face
 64 inclined face
 65 downstream face
 66 apex
 67 inclined face
 68 step face
 70 partition member
 71 support section
 71a first fitting section
 71b second fitting section
 72 side face
 73 cut-away section
 73a upstream side cut-away section
 73b downstream side cut-away section
 74 upstream face
 75 downstream face
 76 step face
 77 tip receiving face
 78 step face
 80 projecting wall section
 81 upstream face
 82 side face
 83 downstream face
 84 planar section
 85 rib-shaped projection
 86 step face
 87 diameter expansion face
 90 annular flange
 91 upstream face
 92 planar section
 93 annular rib
 100 male connector
 101 tip
 101a tip peripheral face
 101b tip flat face
 101c tip curved face
 103 flow path of male connector
 104 tip opening
 110 infusion set
 111 infusion solution tube
 112 roller clamp
 113 air vent filter
 114 clamp

1000 connector
 600 flow path
 3800 connection flow path
 B insertion direction of male connector
 5 C direction perpendicular to insertion direction of male connector
 D removal direction of male connector
 E circumferential direction around the central axis of tubular flow path
 10 O central axis of tubular flow path
 W1 width of partition section interposed between flow paths
 W2 width of inner wall defining connection flow path

The invention claimed is:

- 15 **1.** A connector comprising:
 a housing comprising:
 an insertion section into which a male connector is insertable from an outside of the housing,
 an inner wall defining a flow path that communicates with the insertion section,
 an inclined tip receiving face configured to receive a tip of the male connector, and
 a partition section having a liquid barrier face, wherein the inner wall, the inclined tip receiving face, and the partition section are formed together as a single piece; and
 20 an elastic valve body having a slit and configured to block the insertion section,
 wherein the housing is configured such that, when the male connector is inserted in the insertion section, the liquid barrier face faces a tip opening of the male connector in an insertion direction of the male connector such that liquid flowing out from the tip opening collides with the liquid barrier face, and
 25 wherein at least one connection flow path extends in the insertion direction (i) through the inclined tip receiving face, or (ii) at a location radially inward of the inclined tip receiving face.
- 30 **2.** The connector according to claim 1, wherein:
 the partition section divides the flow path in a direction perpendicular to the insertion direction, and
 the liquid barrier face comprises an upstream face which is a face of the partition section on an upstream side in the insertion direction.
- 35 **3.** The connector according to claim 2,
 wherein the partition section divides the flow path into a plurality of separated flow paths in the direction perpendicular to the insertion direction.
- 4.** The connector according to claim 2,
 40 wherein the upstream face is in a plane extending in the direction perpendicular to the insertion direction.
- 5.** The connector according to claim 2,
 wherein the upstream face is an inclined face descending from the upstream side to the downstream side in the insertion direction.
- 45 **6.** The connector according to claim 2,
 wherein the partition section has a substantially round outer shape when viewed from the insertion direction.
- 7.** The connector according to claim 1, wherein:
 50 the housing comprises a projecting wall section projecting inward from the inner wall, and
 the liquid barrier face comprises an upstream face of the projecting wall section on an upstream side in the insertion direction.
- 55 **8.** The connector according to claim 3, wherein a maximum width of the partition section interposed between the flow paths is smaller than an internal diameter of the housing

defining an insertion opening that is one end of the insertion section when the housing is viewed from the insertion direction.

9. The connector according to claim 1, wherein:
the liquid barrier face is positioned on a downstream side 5
with respect to the tip receiving face in the insertion
direction.

10. An infusion set comprising the connector according to claim 1.

11. The connector according to claim 1, wherein the at 10
least one connection flow path comprises a first connection
flow path that extends in the insertion direction through the
inclined tip receiving face on a first side of the partition
section, and a second connection flow path that extends in
the insertion direction through the inclined tip receiving face 15
on a second side of the partition section.

12. The connector according to claim 7, wherein the at
least one connection flow path comprises a single connec-
tion flow path that is defined on a first side by the inner wall
of the housing and on a second side by a side face of the 20
projecting wall section.

13. The connector according to claim 12, wherein a center
axis of the housing extends through the single connection
flow path.

14. The connector according to claim 12, wherein the 25
upstream face of the projecting wall section comprises a
planar section extending in a direction perpendicular to the
insertion direction, and a rib-shaped projection projecting
from the planar section in a removal direction of the male
connector. 30

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